HEAT EXCHANGER UNIT (HEU-T90) POWER, COOLING, AND CONTROL SYSTEM

Figures

Figures (continued)

Tables

Overview

The heat exchanger unit (HEU-T90) removes heat generated within a module cabinet. The HEU-T90 consists of four basic systems: a dielectric-coolant system, a water system, a power system, and a control system.

Dielectric coolant circulates through the module cabinet and absorbs heat generated by the modules and power supplies. This heated dielectric coolant then flows to the HEU-T90 where the heat is exchanged from the dielectric coolant to water.

An optional configuration of the HEU-T90 allows the connection to an RCU. In this case, heat is not exchanged from the dielectric coolant to water. Heat is exchanged from the dielectric coolant to evaporative refrigerant (R-22).

The control system monitors certain conditions within the HEU-T90 to ensure they are within specific ranges. If the conditions are out of range, the control system either adjusts valves within the HEU-T90 to compensate for the out-of-range condition or shuts the computer system down to protect the equipment and computer room environment from damage.

Refer to Table 1 for the HEU-T90 mainframe physical, power, cooling, and control system specifications. Refer to Figure 1 for an illustration of the HEU-T90.

Table 1. HEU-T90 Specifications

Characteristic	Specification
Dimensions: Height Width Depth	 67.75 in. (1,721 mm) 51.00 in. (1,295 mm) 48.90 in. (1,242 mm)
Weight:	5,600 lbs (2.540 kg)
Dielectric coolant: Standard flow rate	 100 g.p.m.
Water/glycol mixture: Standard flow rate	 100 g.p.m.
Input power: To electrical control box	 460-Vac

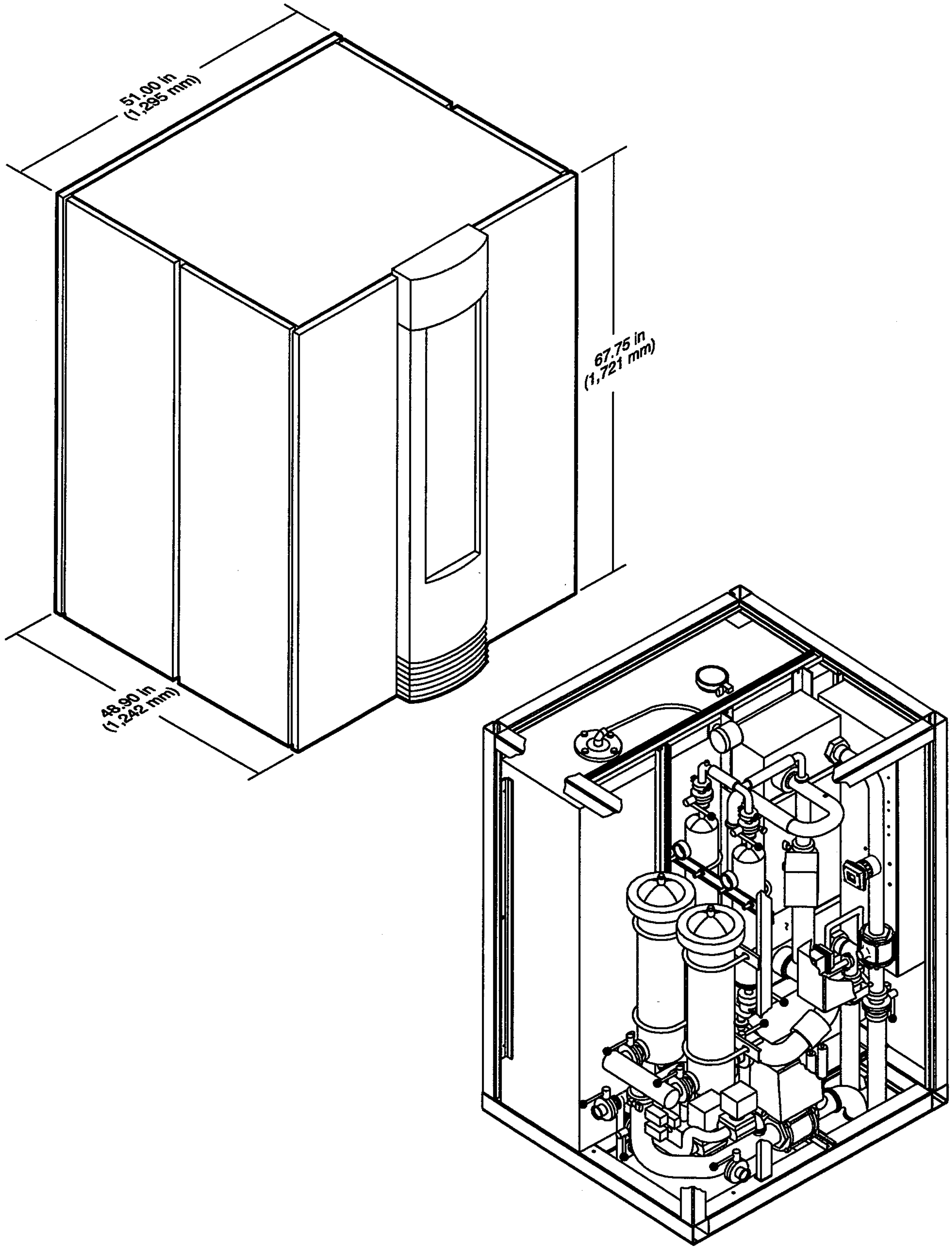


Figure 1. HEU-T90

Components

Refer to Figure 2, Part 1 for an illustration of the following HEU-T90 components.

Fluid-conditioning System

Chemical filtration is done with the fluid-conditioning system (FCS) which consists of two filters. The filters are in parallel with the dielectric-coolant line going into the heat exchanger.

Each FCS filter has a glass PFIB indicator window that contains a combination of white and colored beads. If the filter has been expended, all the beads will be a uniform color, and the filter needs to be replaced.

Dielectric coolant normally flows through both filter housings. The flow can be diverted through a single filter housing if a filter needs to be changed. This feature enables the system to keep running while the filters are changed.

Particulate Filters

Particulate filters remove any particles larger than 1.5 microns from the dielectric coolant. The HEU-T90 is equipped with two particulate filters. Each filter is a cylindrical stainless steel housing with three filter elements.

Dielectric coolant normally flows through both filter housings. The flow can be diverted through a single filter housing if a filter needs to be changed. This feature enables the system to keep running while the filters are changed.

Fluorinert Liquid Bypass Valve (V4)

The Fluorinert liquid bypass valve routes warm dielectric coolant around the heat exchanger. This bypass valve maintains the flow rate of the water at a higher rate, which helps extend the life of the heat exchanger.

Computer systems with smaller configurations generate smaller heat loads. The amount of water flow necessary to remove heat from the dielectric coolant in the heat exchanger is also less. However, reducing the amount of water flow also reduces the efficiency and the life span of the heat exchanger.

The Fluorinert liquid bypass valve maintains a higher water-flow rate, which makes the dielectric coolant coming out of the heat exchanger colder than it should be. The Fluorinert liquid bypass valve routes the warm dielectric coolant around the heat exchanger and mixes it with the colder dielectric coolant, which brings the temperature of the dielectric coolant up to standard temperature.

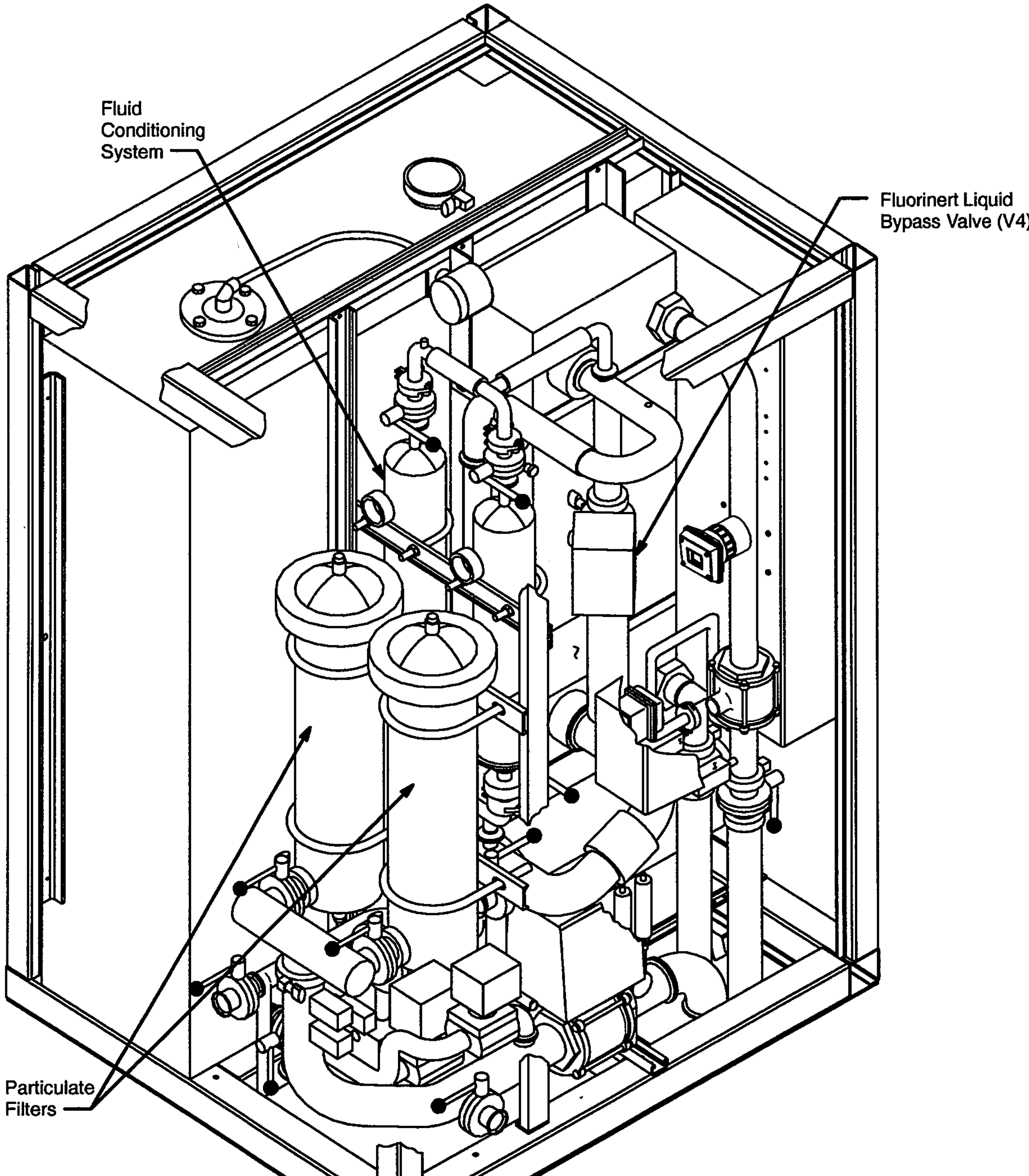


Figure 2. HEU-T90 Components (Part 1 of 5)

Refer to Figure 3, Part 2 for an illustration of the following HEU-T90 components.

Supply Valve (V0) The supply valve is a control valve on the supply line that controls the flow rate of dielectric coolant to the module cabinet. This valve is controlled by the control system and is adjusted according to the measurements taken by the flow meter located on the discharge side of the pump. This supply valve is also used during the reservoir filling process, during which the supply valve is closed to prevent the dielectric coolant from flowing to the module cabinet. Instead, the dielectric coolant is routed to the reservoir.

Drain Valve (V2) The drain valve is a solenoid control valve that is normally open. It provides make-up fluid from the reservoir to the circulation loop and maintains the net positive suction head pressure required for proper operation of the pump; this valve is also used to drain the HEU reservoir. During normal operation, the valve is open and enables the pump to suction the dielectric coolant through the pump to the rest of the HEU.

Fill Valve (V3) The fill valve is a solenoid control valve that is normally closed. When activated, the valve opens, which allows the dielectric coolant to fill the HEU reservoir.

Drain Port The drain port is used to drain the reservoir of dielectric coolant. A dielectric-coolant container can also be connected to this port. When the Drain/Fill switch is toggled to Drain, the HEU pump draws the dielectric coolant through the HEU-T90 to the drain port, which is located after the particulate filters, so that any dielectric coolant drained from the system is filtered.

Supply Line The supply line provides the computer system with filtered dielectric coolant that is kept at a controlled temperature and flow rate.

Return Line The return line routes the dielectric coolant from the mainframe to the HEU. The return line connects with the HEU-T90 pump.

Fill Port The fill port is used to fill the reservoir with dielectric coolant. A dielectric-coolant container can be connected to this port. When the Drain/Fill switch is toggled to Fill, the HEU pump draws the dielectric coolant from the container into the reservoir.

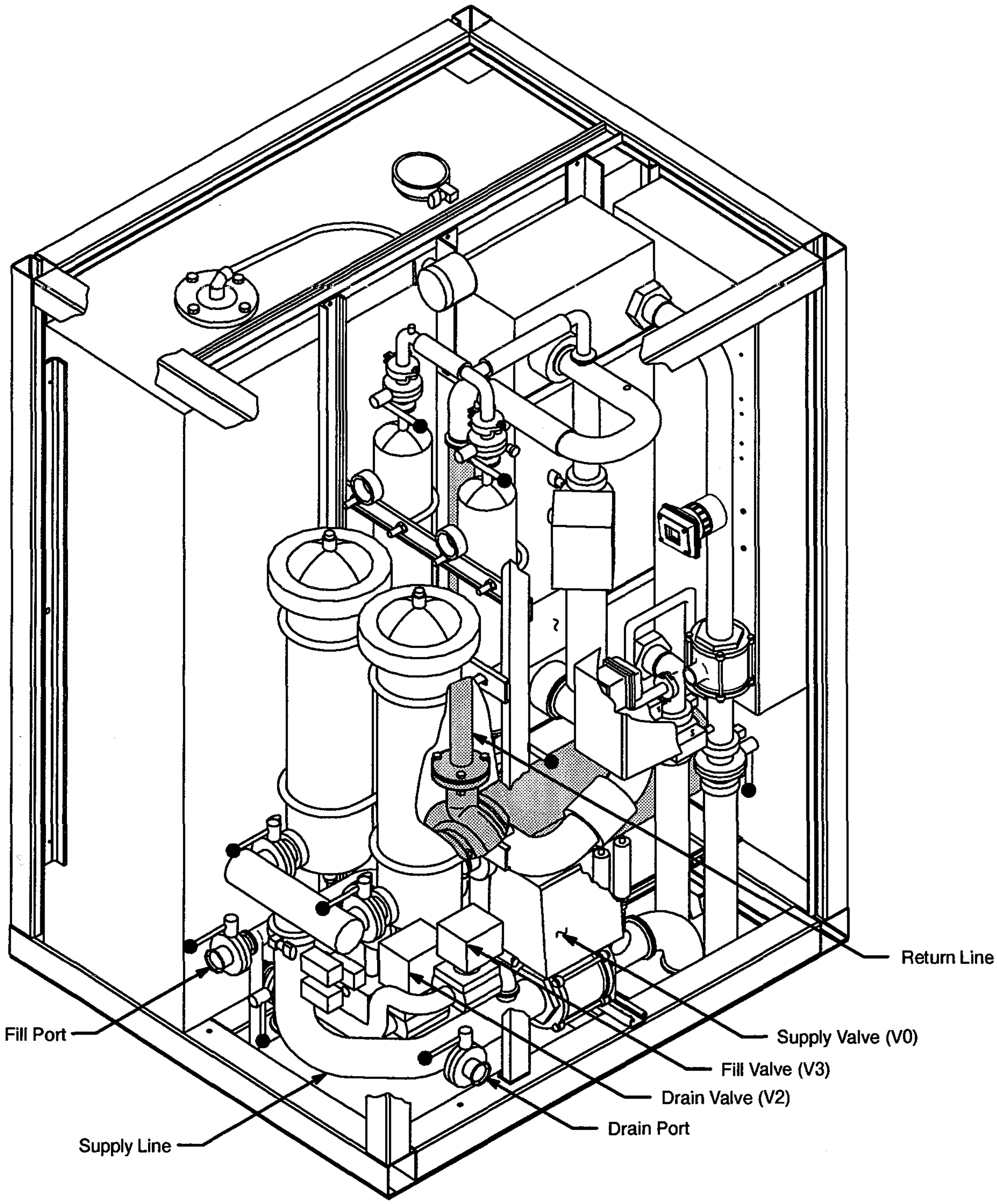


Figure 3. HEU-T90 Components (Part 2 of 5)

Refer to Figure 4, Part 3 for an illustration of the following HEU-T90 components.

Return Valve (V1)

The return valve is an on/off control valve on the return line that controls the flow of dielectric coolant during the reservoir draining process. Normally, the valve is open (on) and allows dielectric coolant to flow through the return line to the pump. During the reservoir draining process, this valve is turned off (closed), which causes the dielectric coolant to be suctioned from the reservoir through the pump and the rest of the HEU.

Reservoir

The reservoir can hold 225 gallons of dielectric coolant. When the computer system is powered down, the dielectric coolant is drained from the module cabinet and stored in the reservoir. Dielectric coolant is pumped from the reservoir into the computer system when the computer system is running.

A 4-in. reservoir fill port is located on top of the reservoir. This port is used to add dielectric coolant when needed. The dielectric coolant is poured directly into the reservoir through this port. In addition, the reservoir has two lines coming into it: a drain/fill line and a vent/charge line.

Reservoir Fill Port

The reservoir fill port is used to fill the reservoir with dielectric coolant. A dielectric-coolant container is connected to this port, which is located before the pump. When the Drain/Fill switch is toggled to Fill, the HEU pump starts to pump and the dielectric coolant is suctioned into the reservoir.

Vent/Charge Line

The vent/charge line is used during the fill process. While the mainframe is being filled with dielectric coolant, any air in the lines and mainframe is forced through the vent/charge line back to the HEU reservoir.

IOS/SSD Dielectric-coolant Supply Line

The IOS/SSD dielectric-coolant supply line provides the IOS/SSD chassis with cool dielectric coolant that is kept at a controlled temperature and flow rate.

IOS/SSD Dielectric-coolant Return Line

The IOS/SSD dielectric-coolant return line routes the warm dielectric coolant from the IOS/SSD chassis to the HEU where it mixes with the dielectric coolant coming from the mainframe chassis.

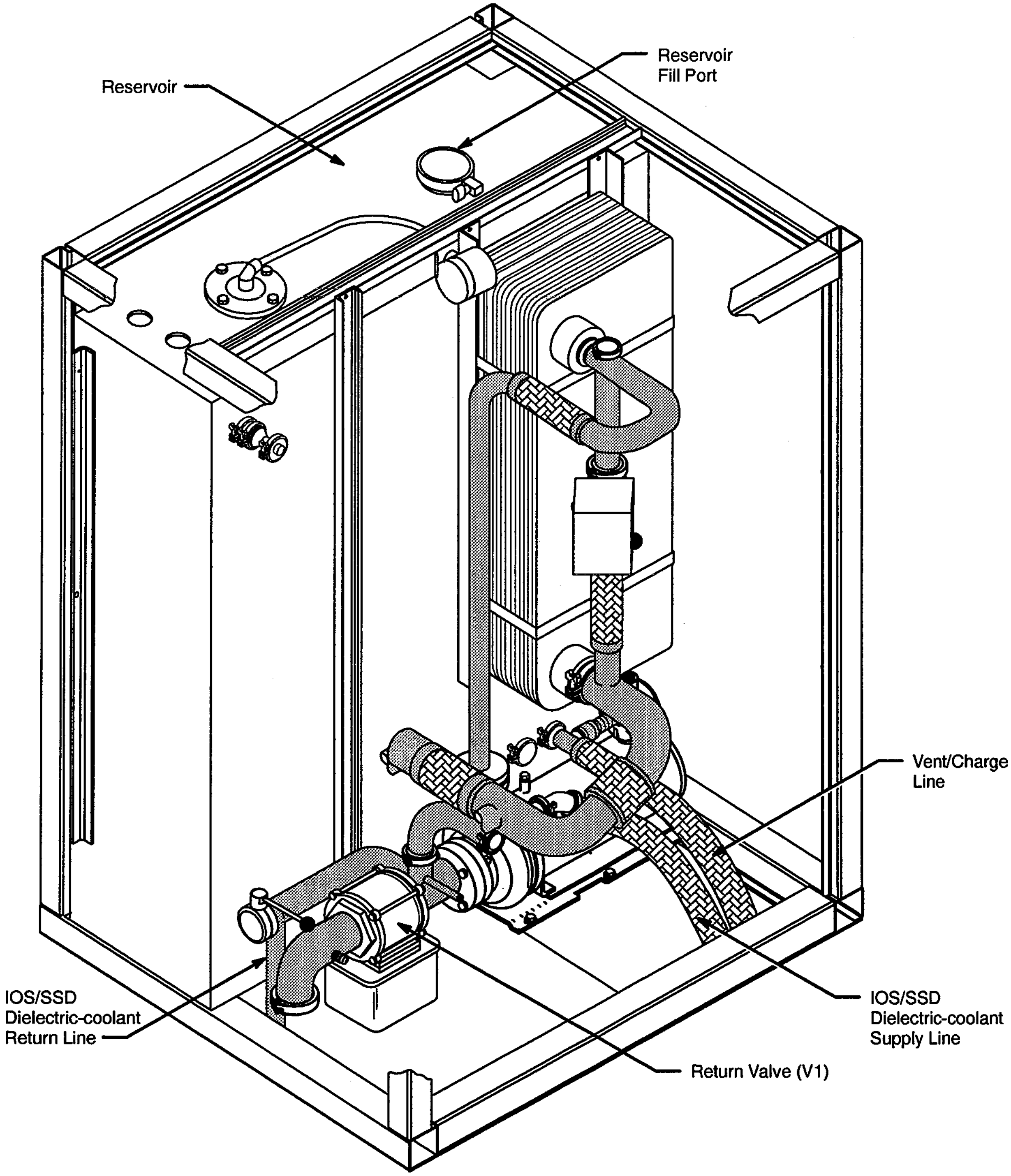


Figure 4. HEU-T90 Components (Part 3 of 5)

Refer to Figure 5, Part 4 for an illustration of the following HEU-T90 components.

Heat Exchanger

The heat exchanger is where the heat exchange between the dielectric coolant and water takes place. The heat exchanger is a brazed assembly of thin corrugated metal plates stacked on top of each other.

The heated dielectric coolant enters the heat exchanger and flows through the channels formed by the stacked metal plates. Cold water also flows through the heat exchanger in channels adjacent to the dielectric-coolant channels. The dielectric coolant always flows in the opposite direction of the cold water. Heat is conducted from the warm dielectric coolant to the cold water.

Water Control Valve (V5)

The water control valve controls the amount and flow of the water entering the heat exchanger. This valve can be adjusted by the control system. The temperature transducers monitor the temperature of the dielectric coolant as it leaves the heat exchanger. If the temperature transducers detect an out-of-range temperature, the control system adjusts this valve accordingly.

Water Bypass Valve (V6)

The water bypass valve is a solenoid control valve that routes the water around the heat exchanger when the HEU is not operating. If desired, water is routed from the water supply line through the water bypass valve and through the water bypass line to the return line. The water flows at a reduced flow rate to reduce delays in system start-up time, which can be caused by stagnant water loops warming to room temperature.

Water Supply Line

The water supply line provides cool water from the customer's water source to the heat exchanger.

Water Return Line

The water return line routes the heated water from the heat exchanger to the customer's water source.

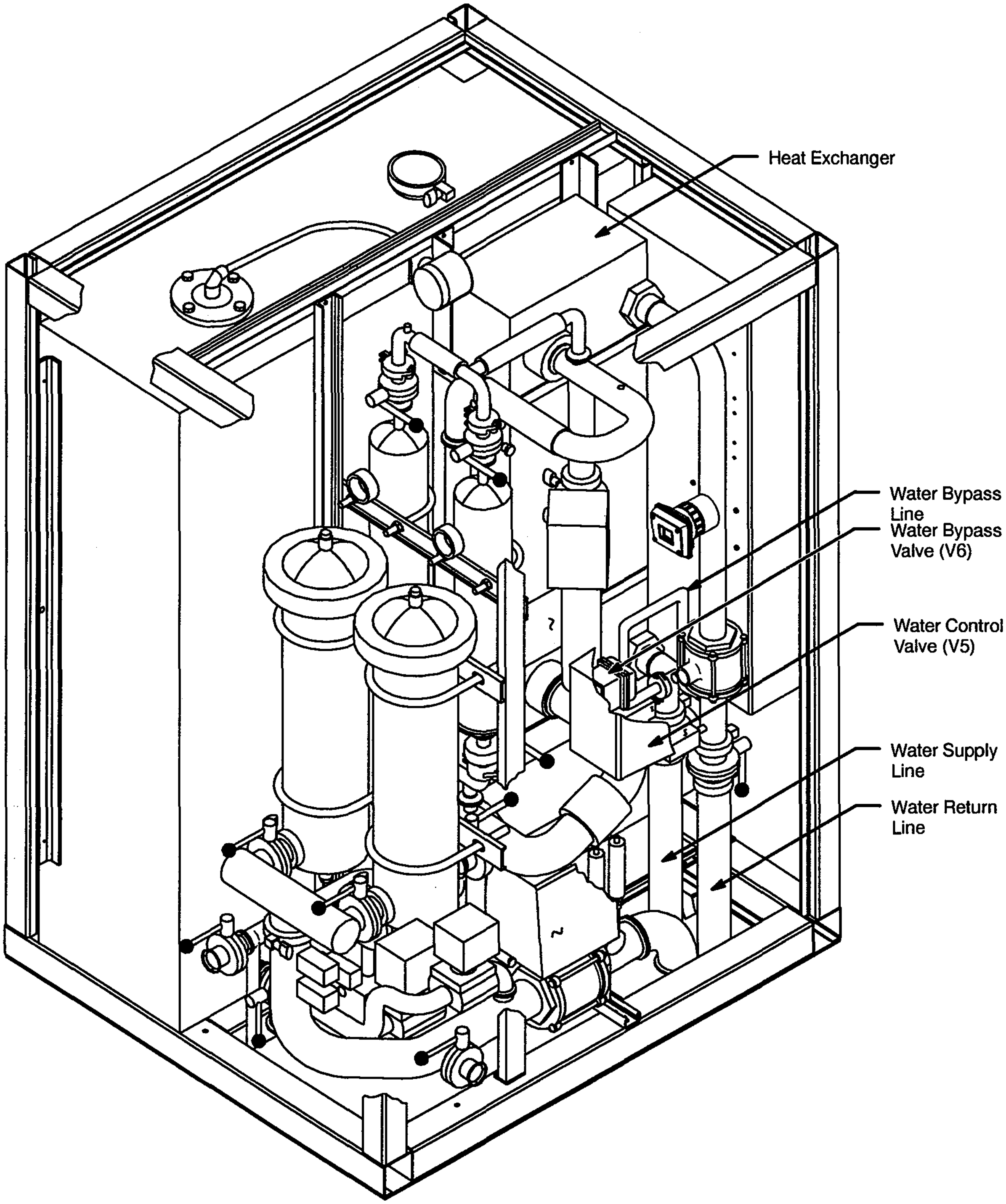


Figure 5. HEU-T90 Components (Part 4 of 5)

Refer to Figure 6, Part 5 for an illustration of the first three HEU-T90 components described below.

Centrifugal Pump

The centrifugal pump circulates dielectric coolant through the computer system. The pump draws dielectric coolant through the HEU-T90 and module cabinet. This pump operates on 50- or 60-Hz, 3-phase, 360-Vac to 480-Vac power supplied by the 3-pole male connector connected to the electrical control box. The pump is protected by a contactor and overload relay. It also has overtemperature circuitry that protects the pump from damage if an overload causes the temperature to become too high.

Electrical Control Box

The electrical control box contains the main circuit breaker, transformer, power on/off switch, and electrical connections for the HEU-T90. Refer to the "Power System" subsection in this document for more information about the electrical control box.

Control System

The control system (GE Fanuc Genius I/O System) monitors flow, temperature, pressure, and dielectric-coolant levels within the HEU-T90. The HEU-T90 contains five remote monitoring blocks that provide an interface between the controller on the mainframe and the sensors within the HEU-T90. Refer to the "Control System" subsection for more information about the HEU-T90 control system.

Butterfly Valves (Not Shown)

Butterfly valves are manual valves that are used to isolate pieces or areas of equipment within the HEU-T90.

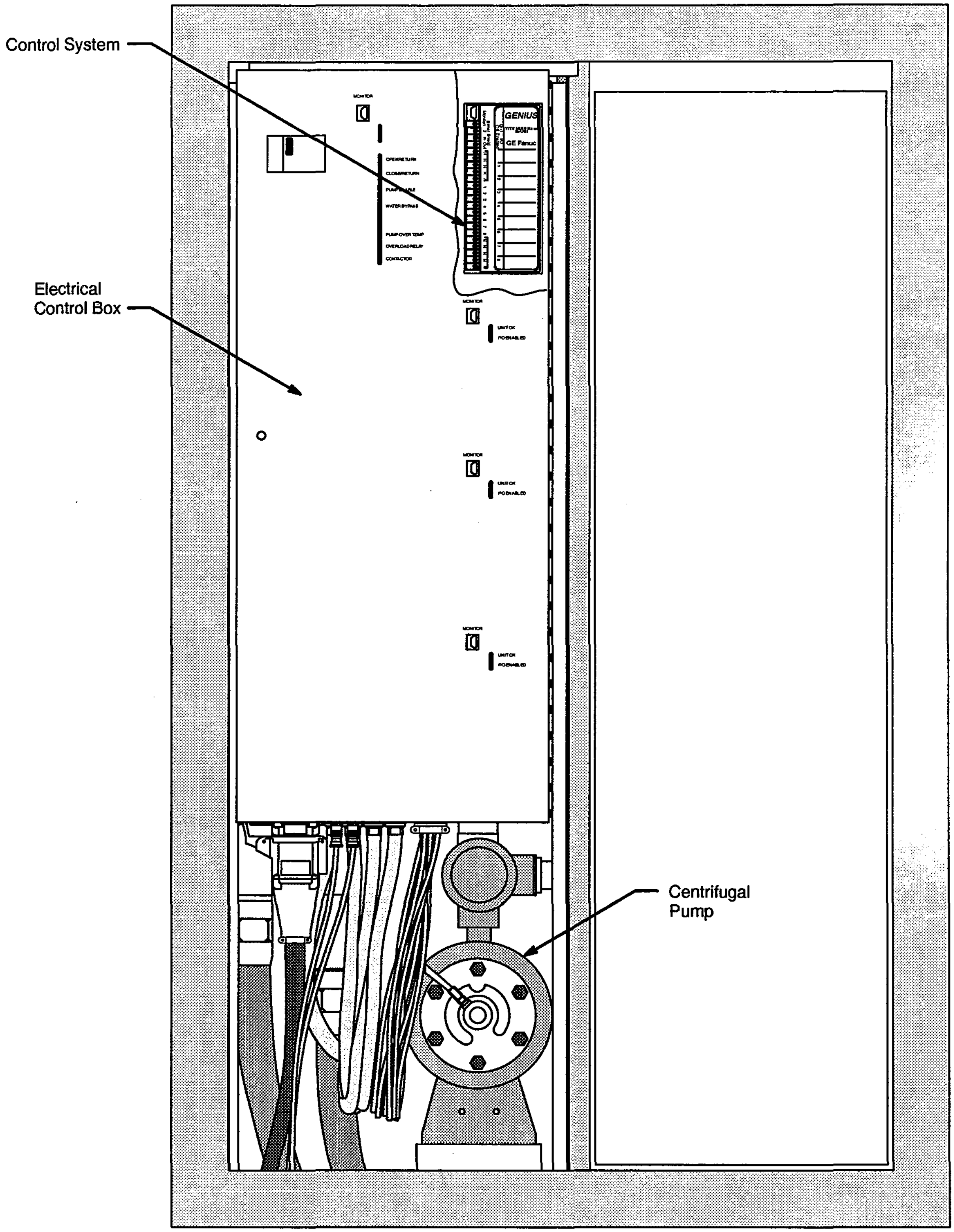


Figure 6. HEU-T90 Components (Part 5 of 5)

Dielectric-coolant Flow Circuit

Normal Operation

Refer to Figure 7 for an illustration of the HEU-T90. The shaded areas indicate components that are part of the dielectric-coolant flow circuit. The following description includes circled numbers that correspond with the numbers shown in Figure 7.

Dielectric coolant is pumped through the computer system to absorb heat and through the HEU-T90 to remove the heat to water. When the computer system is powered down, all dielectric coolant is removed from the computer system. This dielectric coolant is stored in the reservoir ① within the HEU-T90.

When the computer system is powered up, dielectric coolant flows through the supply line ② from the HEU-T90 reservoir to the module cabinet. As the module cabinet is filling, any air that was in the module cabinet or supply line is forced through the vent/charge line into the HEU-T90 reservoir.③

Dielectric coolant absorbs heat in the module cabinet and then flows to the HEU-T90. The pump ④ suctions the dielectric coolant through it and then pumps it to the heat exchanger ⑤, where the heat is removed from the dielectric coolant to water through a heat exchange process. The pipe leading to the heat exchanger is in a slip stream ⑥ with the fluid conditioning system (FCS). Some dielectric coolant flows directly to the heat exchanger while the rest flows through the FCS. Once the dielectric coolant has been filtered in the FCS, the dielectric coolant flows through a pipe that joins the pipe coming from the heat exchanger. ⑦

After the heat has been removed from the dielectric coolant in the heat exchanger, the dielectric coolant flows through the particulate filters ⑧, where any particles that may have been picked up during the cooling process are filtered out. From the particulate filters, the dielectric coolant flows out of the HEU-T90 through the supply line ⑨ and back to the module cabinet.

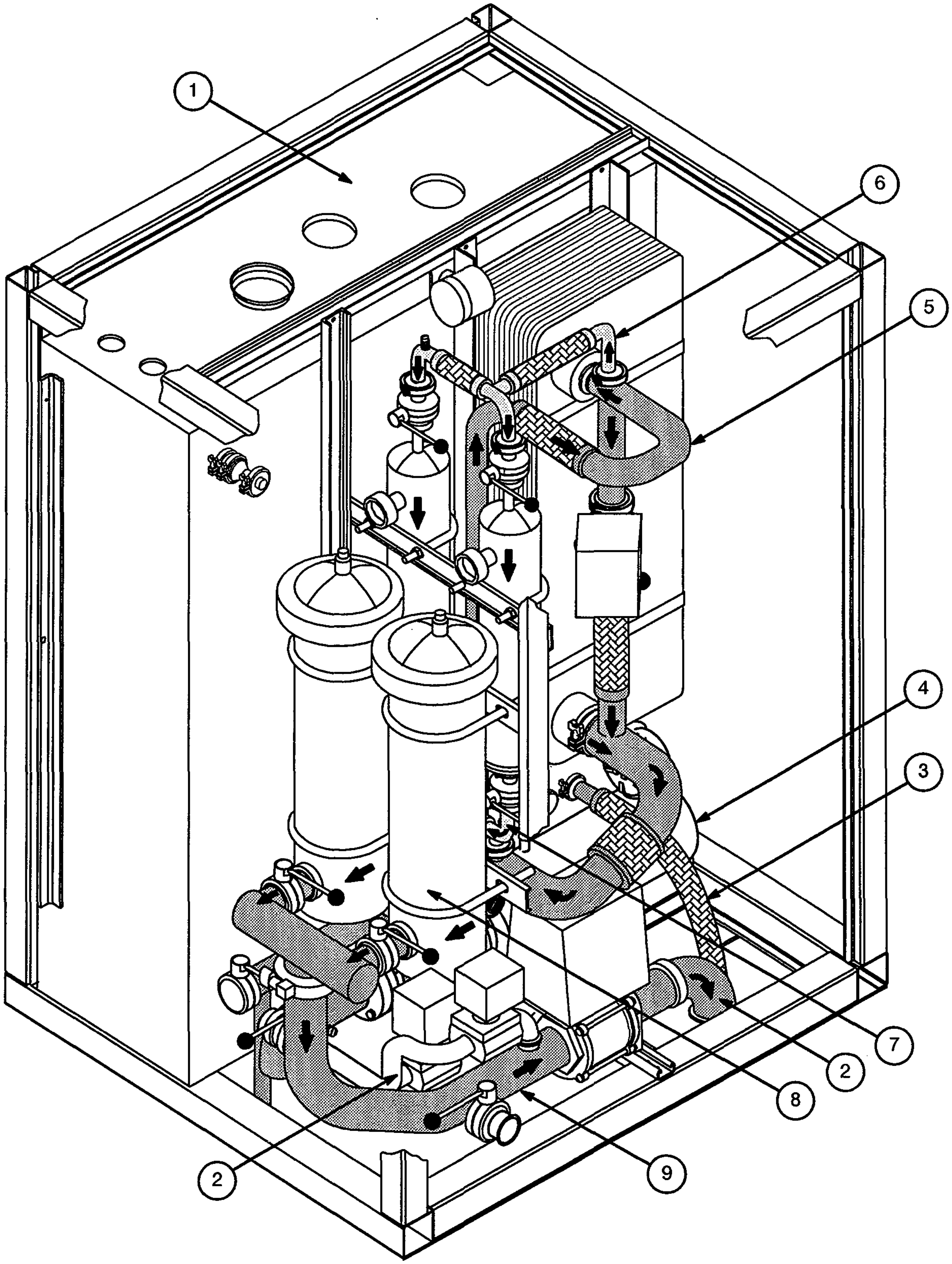


Figure 7. HEU-T90 Dielectric-coolant Flow Circuit

Refer to Figure 8 for an illustration of the HEU-T90 IOS/SSD dielectric-coolant flow circuit. The following description includes circled numbers that correspond with the numbers shown in Figure 8.

In some cases, the HEU-T90 cools an IOS/SSD cabinet in addition to the mainframe. In this instance, the flow of dielectric coolant is relatively the same. The pump suctions the dielectric coolant through the IOS/SSD dielectric-coolant return line① and then mixes with the dielectric coolant coming from the mainframe. ②

The dielectric coolant flows through the heat exchanger where it is cooled ③; the dielectric coolant flows out of the heat exchanger towards the particulate filters ④. Before the dielectric coolant reaches the particulate filters, some of the dielectric coolant flows through the IOS/SSD dielectric-coolant supply line ⑤ back to the IOS/SSD chassis. Because the IOS/SSD chassis does not use an immersion cooling technique, the dielectric coolant does not have to be filtered for PFIBs or particles.

Refer to Figure 9 for an illustration of the HEU-T90 waterfall circuit and connections. The following description includes circled numbers that correspond with the numbers shown in Figure 9.

A lighted waterfall is located on the front of the HEU-T90. This "waterfall" is actually connected to dielectric coolant coming from the reservoir. The front of the waterfall has clear plastic and a light at the top so that the dielectric coolant can be viewed as it cascades to the bottom of the waterfall plenum. The only purpose of this waterfall is aesthetics; no cooling is accomplished using this circuit.

The waterfall supply line connects to the reservoir. The dielectric coolant comes from the reservoir and enters the top of the waterfall plenum. The dielectric coolant cascades down through the waterfall plenum where it flows through an exit hole back to the reservoir.

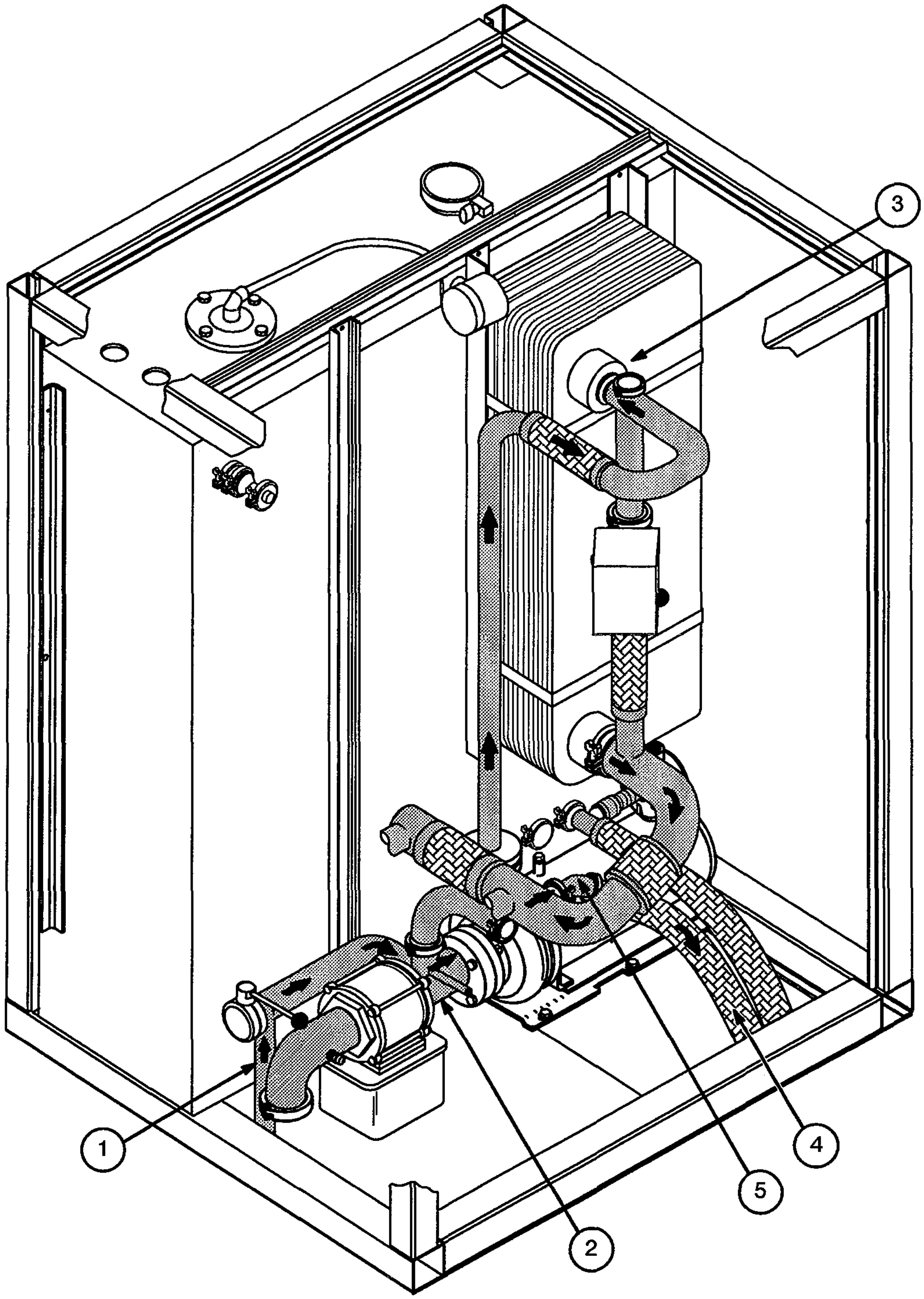


Figure 8. IOS/SSD Dielectric-coolant Flow Circuit

To be provided in next revision. Information not available at this time.

Figure 9. Waterfall Circuit

Reservoir Fill Sequence

When the computer system is shut down, the dielectric coolant is stored in the reservoir. The dielectric-coolant flow circuit deviates from that of normal operation, and a certain sequence of events occurs. The following list describes what happens during the filling process:

1. The computer system shuts down.
2. The supply valve closes.
3. The solenoid control fill valve opens.
4. The supply line control valve closes.
5. Dielectric coolant flows through the HEU just as it does during normal operation, except that it flows through the line with the fill valve instead of going through the supply line to the module cabinet.

Reservoir Drain Process

When the computer system is initially powered up, the dielectric coolant must be drained from the reservoir and circulated through the HEU and then to the computer system. The following list describes the sequence of events during the draining process:

1. The HEU is powered up.
2. The return line control valve is closed.
3. The solenoid control drain valve opens.
4. The pump suctions dielectric coolant from the reservoir through the line with the drain valve, then through the pump, and then through the HEU as in normal operation.

Water Flow Circuit

Water is used in the HEU-T90 to remove heat from the dielectric coolant. The shaded areas in Figure 10 indicate the water flow circuit components.

Water flows from the customer-supplied cooling water source to the HEU-T90 through piping under the computer room floor. The water supply line enters the HEU-T90 and flows to the heat exchanger. A temperature transducer monitors this water supply line.

The water flows through the heat exchanger in channels formed by stacked metal plating. The water flows through these channels in the opposite direction of the dielectric-coolant channels. The water absorbs the heat from the dielectric coolant in the heat exchanger and then flows through the water return pipe, which is monitored with a flow meter and temperature transducer. The water flows back to the customer-supplied tower where the water is cooled for reuse.

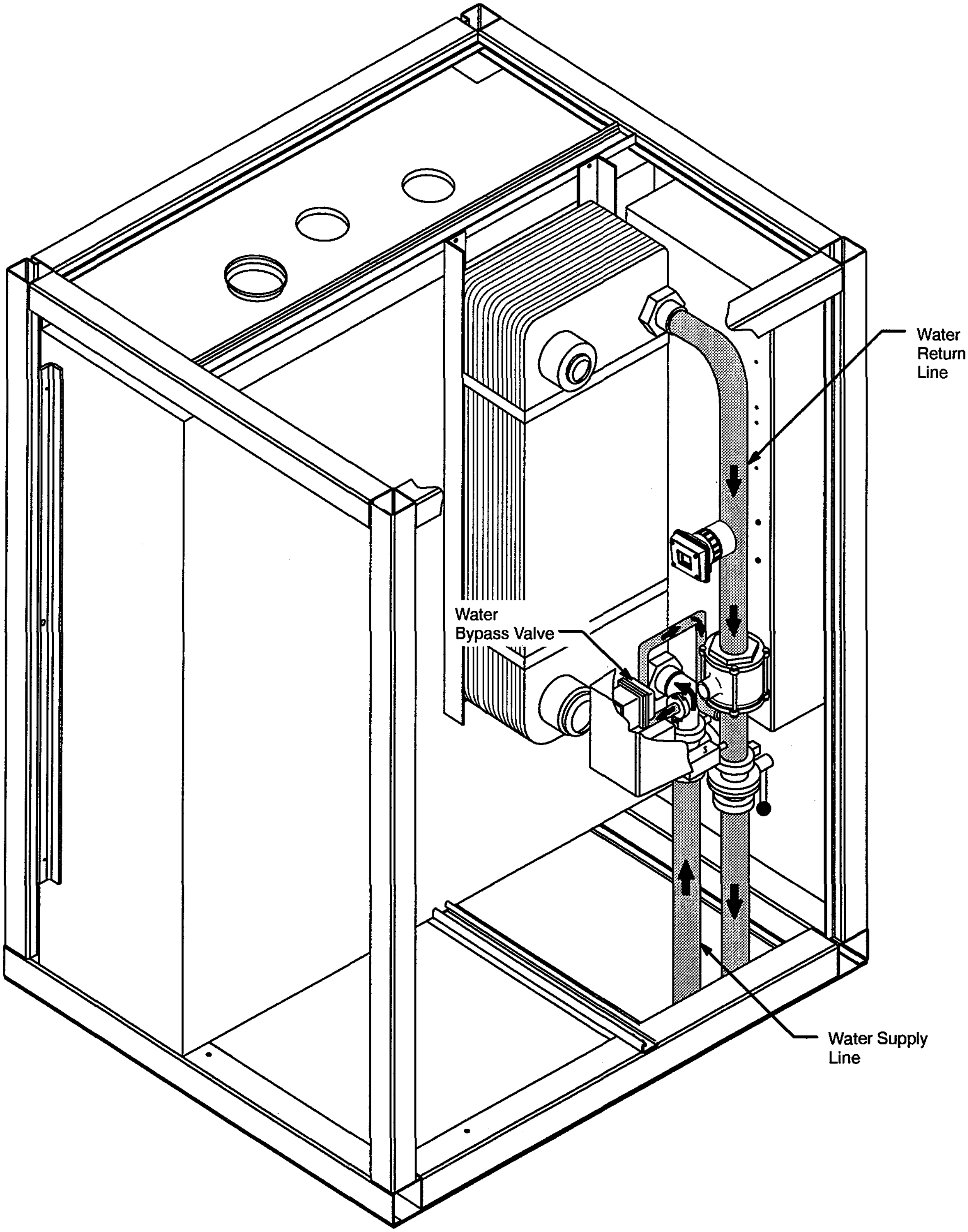


Figure 10. HEU-T90 Water Flow Circuit

Power System

The HEU-T90 has an electrical control box (refer to Figure 11) that receives the 50- or 60-Hz, 3-phase, 400/460-Vac power from the uninterruptable power source (UPS) or utility pole.

Components

- Three-pole male connector (460 V, 50 A)
- Contactor (3 phase, 460 V, 80 A)
- Step-down transformer (460 to 120 V, 500 VA)
- Overload relay
- Circuit breaker (460 V)
- Shunt trip (460 V)
- Circuit breaker (120 V, 3 A)
- Terminal block
- Relays
- 115-Vac remote monitoring blocks
- Analog I/O monitoring blocks

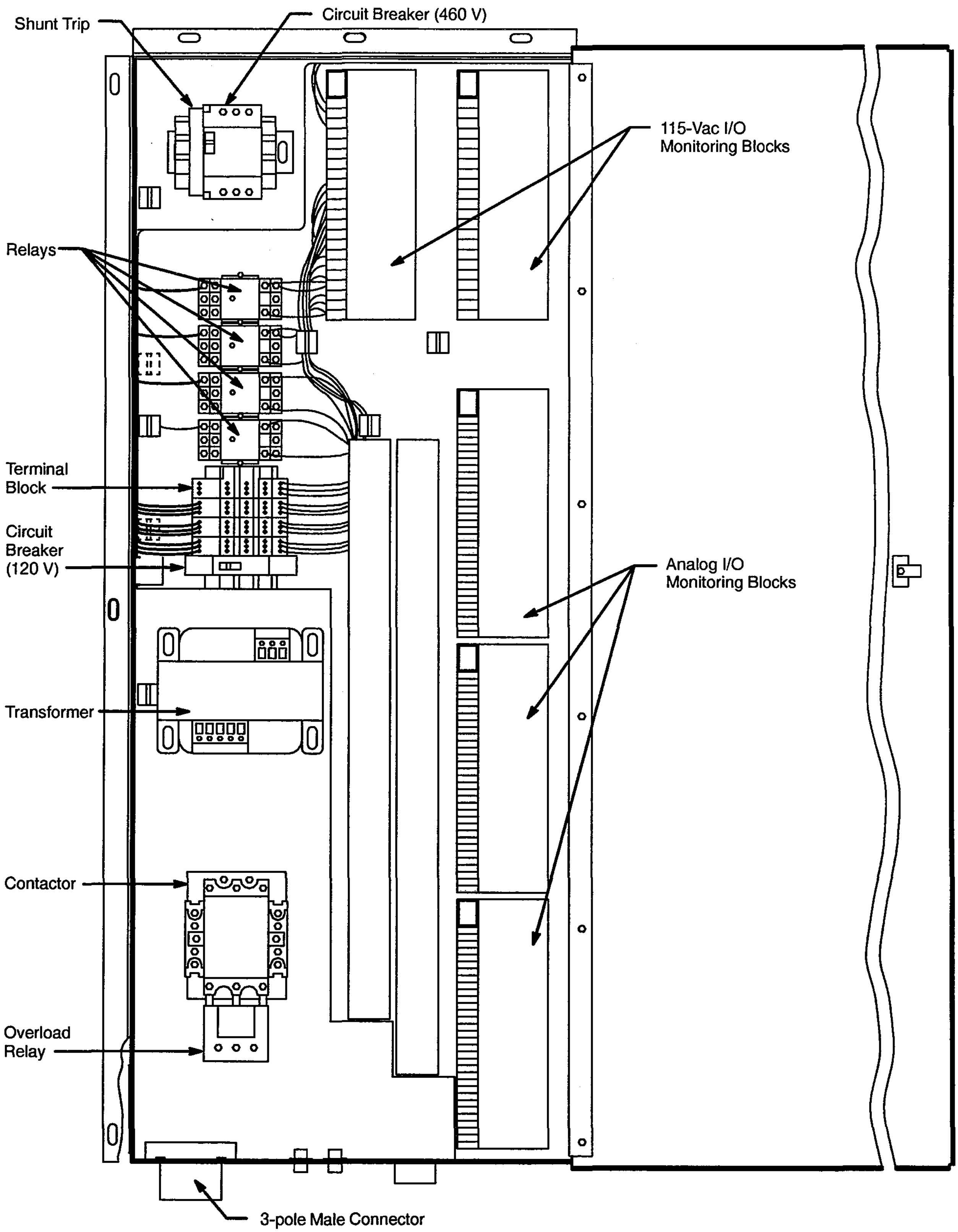


Figure 11. Electrical Control Box

Distribution

Figure 12 is an electrical block diagram of the HEU-T90.

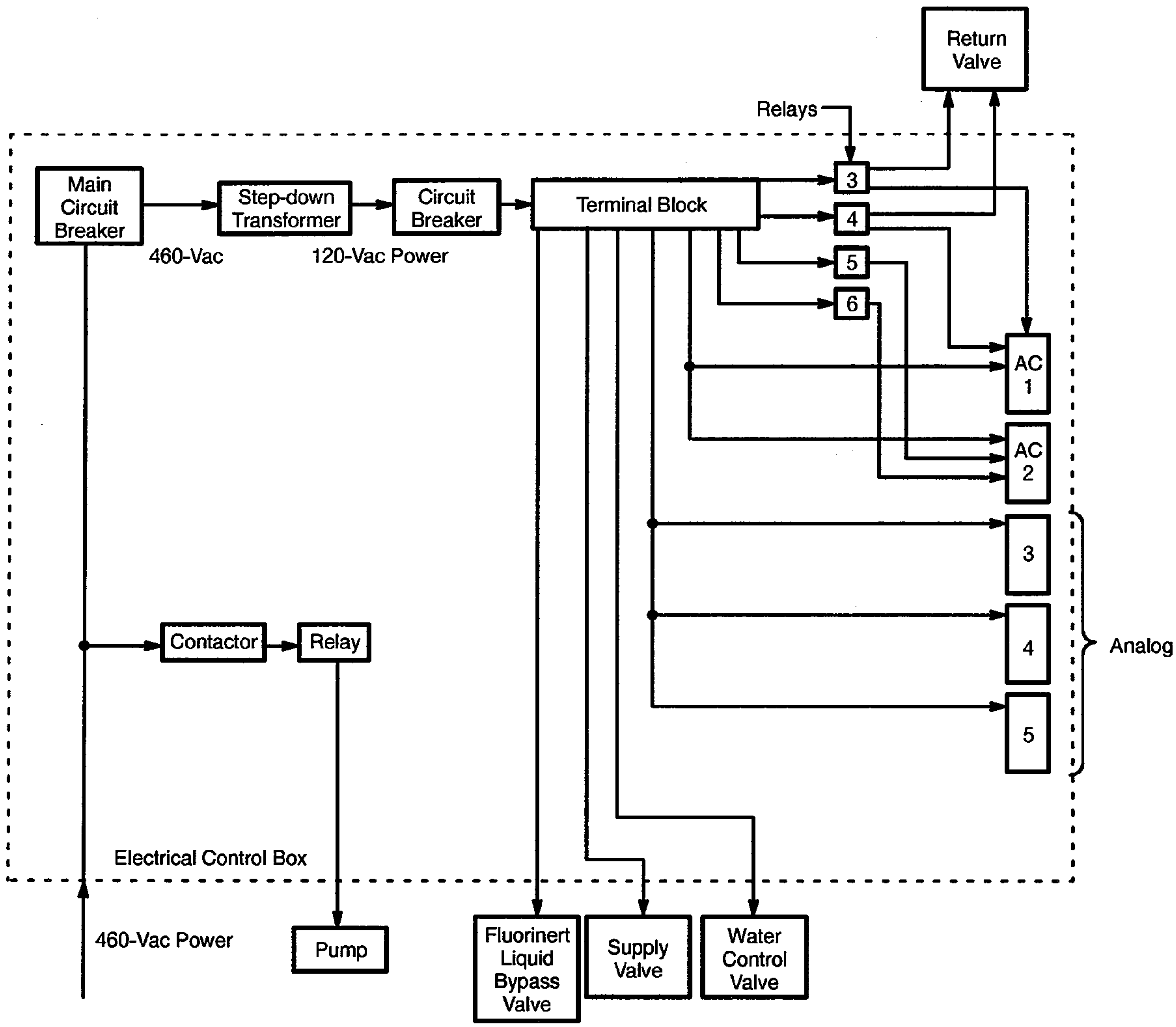


Figure 12. Electrical Block Diagram

The 3-phase, 460-Vac power is connected to the electrical control box with the 3-pole male connector. This power is routed to an 80-A contactor, through an overload relay, and then to the pump; this power from the connector is also routed through the main shunt-trip circuit breaker (power on/off switch) and then to a step-down transformer. The transformer steps down the 460-V power to 120-V power.

This stepped-down power is routed through a 3-A circuit breaker and then to 2-pole bus bar terminal blocks. The terminal blocks provide power to the remote monitoring blocks and four relays contained within the electrical control box. (Refer to the "Control System" subsection in this document for more information about the remote monitoring blocks.)

Two terminal blocks provide power for the relays and remote monitoring blocks. A blue terminal block provides the neutral connections for the relays and the remote monitoring blocks. The other terminal block is gray and is located under the blue terminal block. This gray terminal block provides power for the relays and remote monitoring blocks. Figure 13 provides an illustration of the terminal blocks. Table 2 provides signal information for each terminal block.

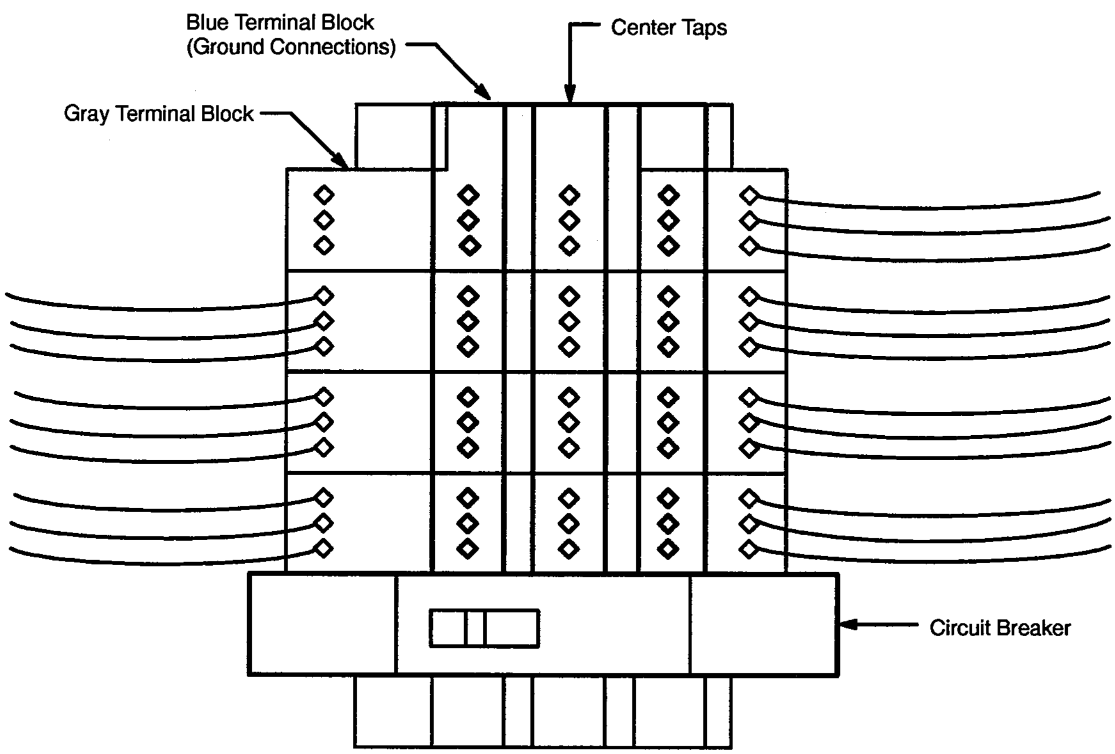


Figure 13. Terminal Block Connections

Table 2. HEU-T90 Terminal Block Connections

Terminal Block	Connection Number	Connected To
Gray (Line Connections)	1	CB2
	2	Contactor
	3 through 18	Not used
	19	115-Vac remote monitoring blocks (1 and 2), connection #5
	20	Analog remote monitoring blocks (3, 4, and 5), connection #6
	21	Supply valve (V0)
	22	Fluorinert liquid bypass valve (V4)
	23	Water control valve (V5)
	24	Relays K3 and K4
Blue (Neutral Connections)	1	
	2	
	3 through 13	Not used
	14	115-Vac remote monitoring blocks (1 and 2), connection #18
	15	Analog remote monitoring blocks (3, 4, and 5) connection #7
	16	Water bypass valve (V6)
	17	Drain valve (V2)
	18	Fill valve (V3)
	19	Return valve (V1)
	20	Supply valve (V0)
	21	Fluorinert liquid bypass valve (V4)
	22	Water control valve (V5)
	23	Relays (K3, K4, K5, and K6)
	24	

The 115-Vac I/O remote monitoring blocks receive power from the terminal blocks and control the relays and solenoid valves. Figure 14 illustrates the four relays and the component to which each relay is connected. Table 3 provides information about each relay connection.

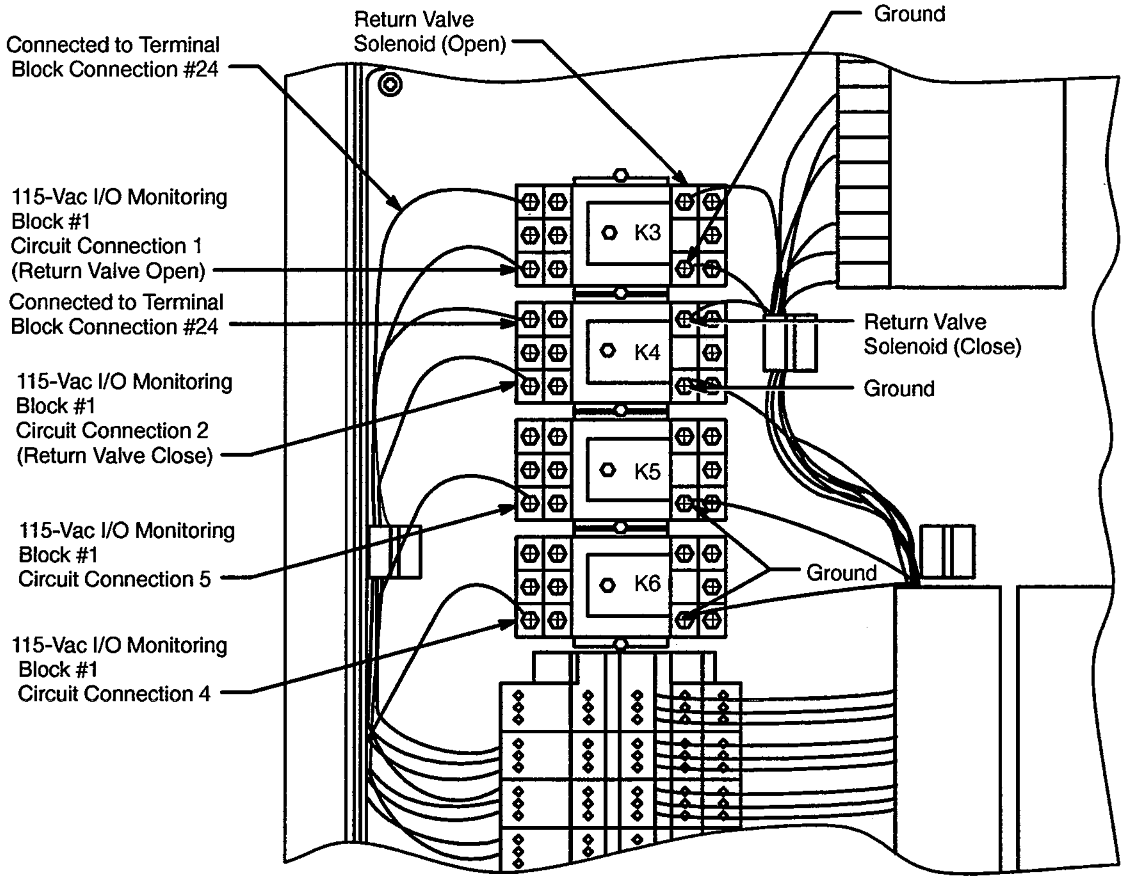


Figure 14. Relay Connections

Table 3. Relay Connections

Connection Number	Relays			
	K3	K4	K5 (Not used)	K6 (Not used)
1				
7	Gray terminal block connection #24	Gray terminal block connection #24		
4	Return valve (open)	Return valve (close)		
3				
9				
6				
A	115-Vac monitoring block #1, circuit #1, connection #10	115-Vac monitoring block #1, circuit #2, connection #11	115-Vac monitoring block #2, circuit #5, connection #14	115-Vac monitoring block #1, circuit #4, connection #13
B	Blue terminal block connection #23	Blue terminal block connection #23	Blue terminal block connection #23	Blue terminal block connection #23

Control System

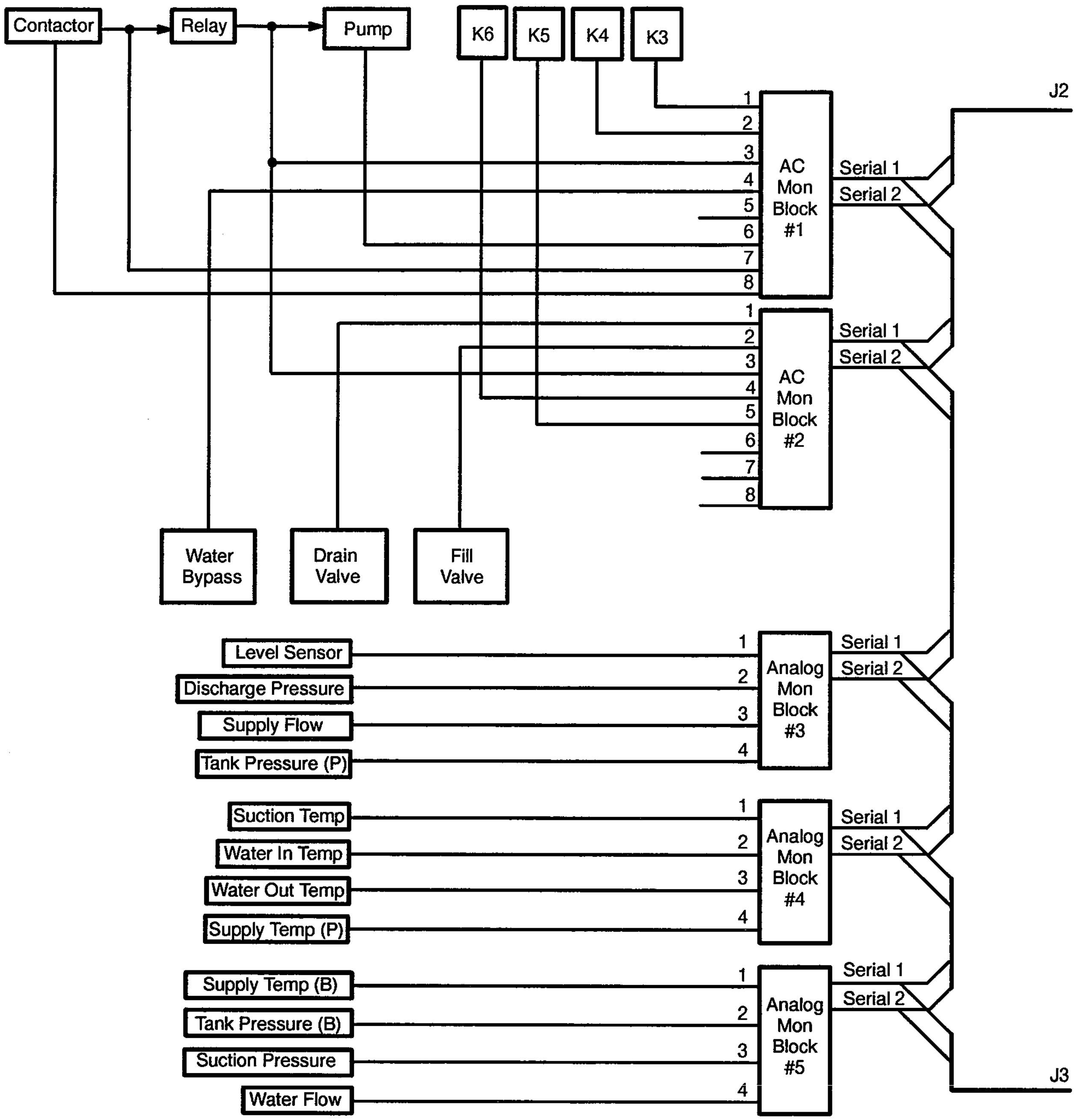
The control system monitors the HEU-T90 for acceptable water and dielectric-coolant temperatures, pressures, and flow rates. The control system also monitors the dielectric-coolant level in the reservoir, drain line, and fill line. This system controls the power-up and power-down process of the HEU-T90 as well as the draining and filling processes of the mainframe and reservoir. Refer to Figure 15 for a block diagram of the control system.

NOTE: This document does not explain the theory of operation for the control system. Only information specific to the HEU-T90 is provided. Refer to the *CRAY T90 Series Control System Overview* document, CRI publication number HTM-xxx-x, for more information.

Components

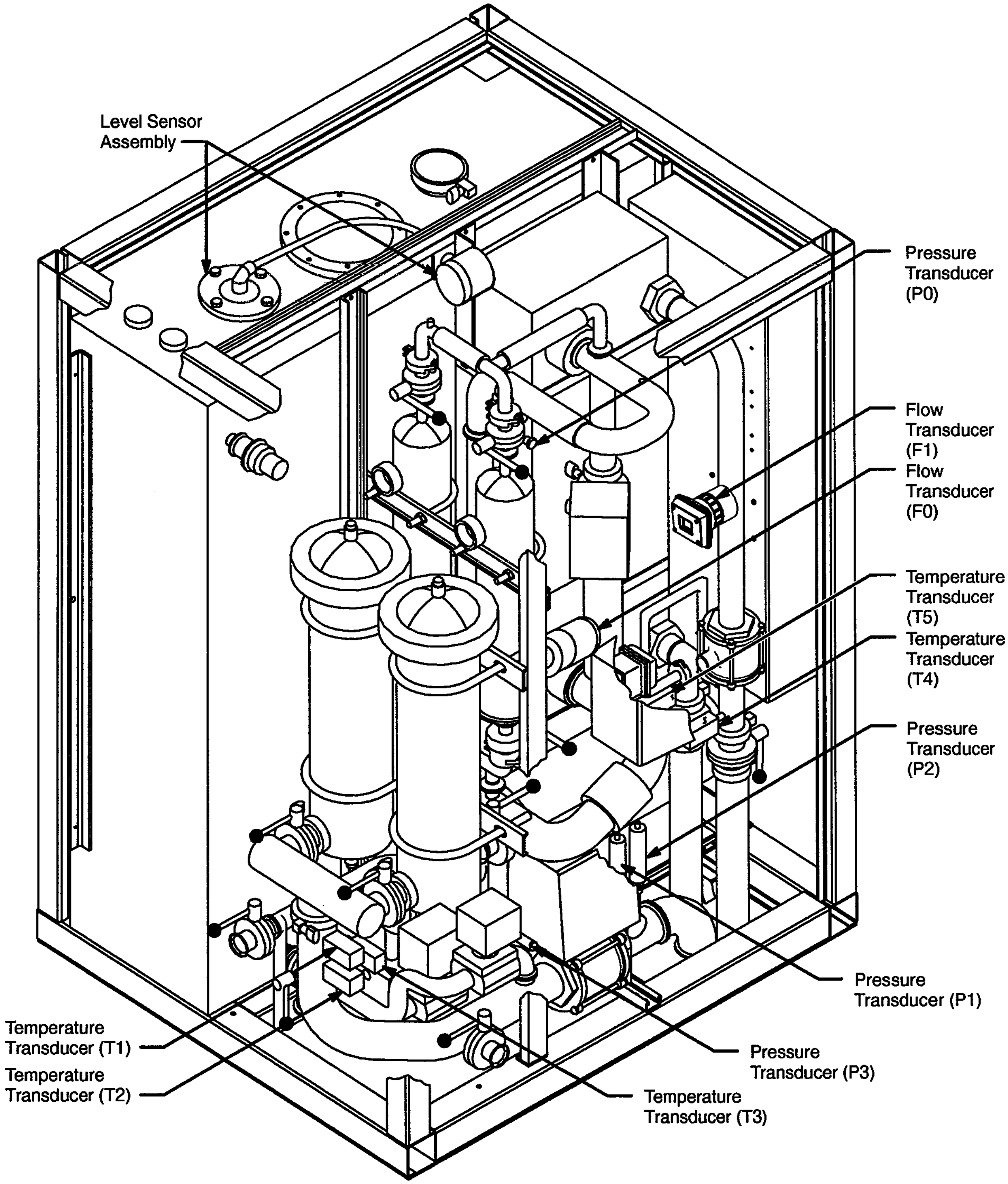
The control system receives inputs from temperature transducers, pressure transducers, flow meters, and level sensors. These transducers and sensor send the monitored information to the remote monitoring blocks, which send the information to the programmable logic controller (PLC) on the mainframe. Refer to Figure 16 for the locations of the control system components. The following list describes each sensor.

NOTE: Each sensor is labeled with an alphanumeric designator; for example, T1, T2, etc.



NOTE: The numbers on the lines indicate the circuit numbers on the remote monitoring blocks.

Figure 15. Control System Block Diagram



NOTE: T0 is located on the pump.

Figure 16. HEU-T90 Control System Component Locations

Two types of remote monitoring blocks are used in the HEU-T90: three analog I/O monitoring blocks and two 115-Vac monitoring blocks. These remote monitoring blocks are located within the electrical control box (refer to Figure 17).

The remote monitoring blocks are numbered 1 through 5 in Figure 17. Refer to Figure 18 and Figure 19 for illustrations of these remote monitoring blocks and to find out what each channel monitors.

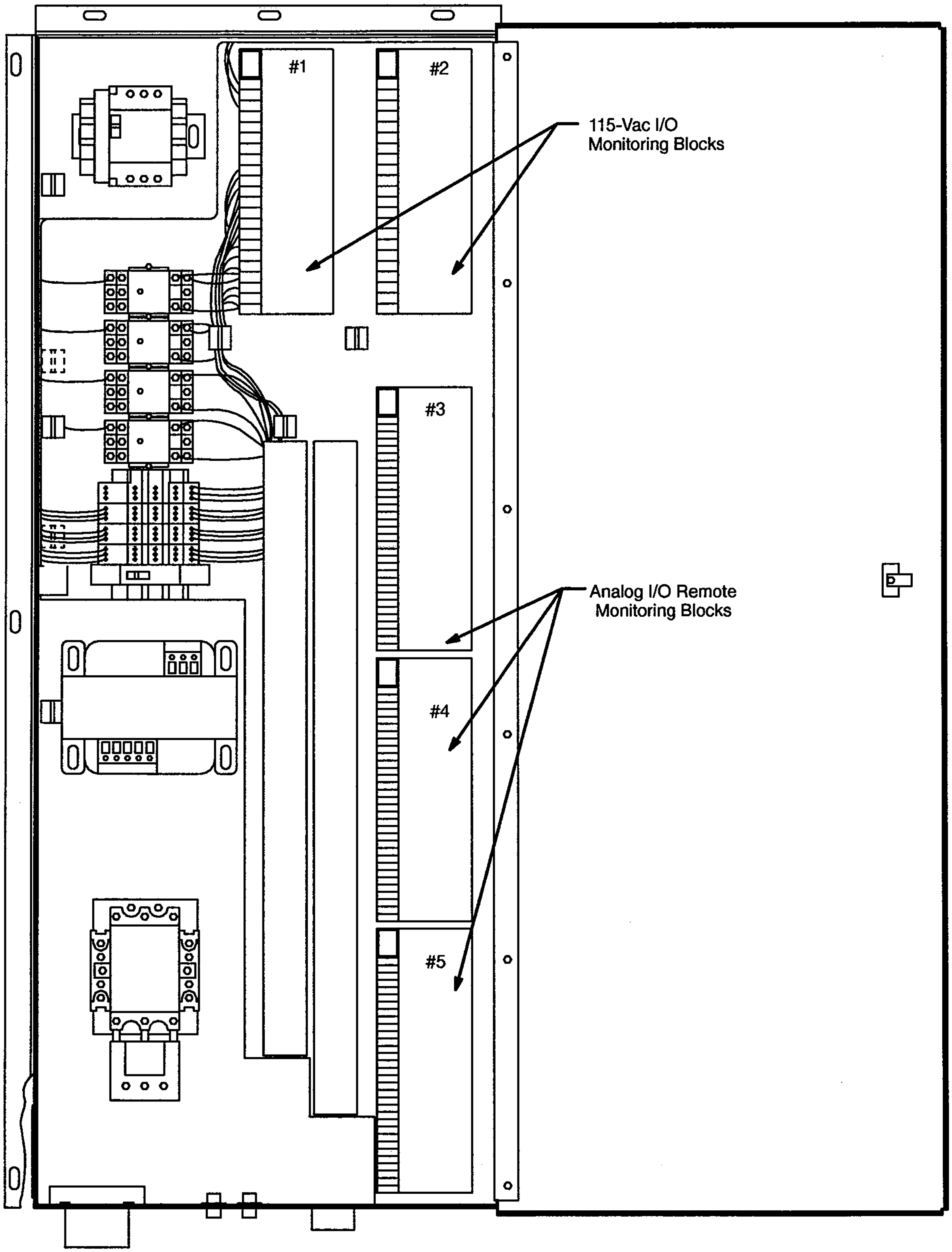


Figure 17. I/O Remote Monitoring Block Locations

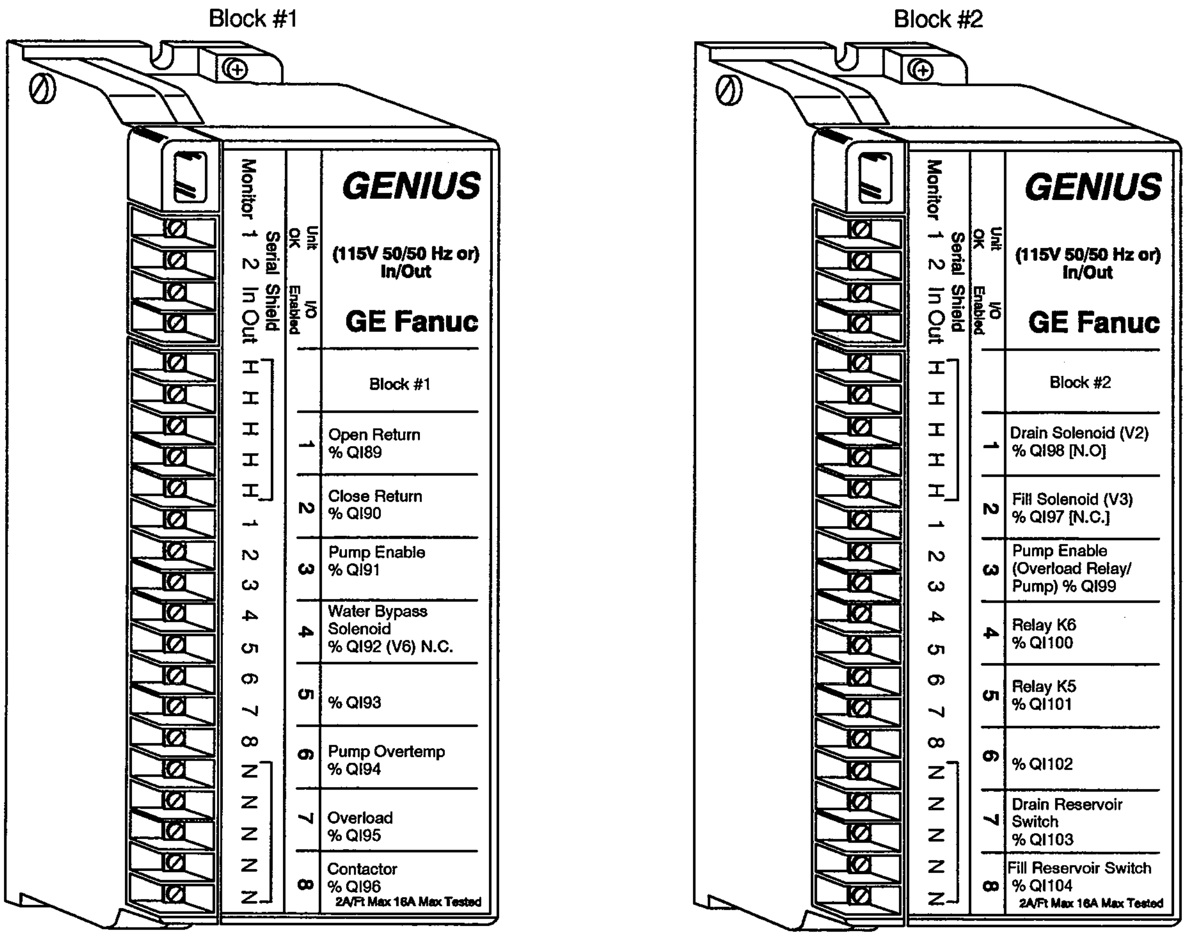


Figure 18. 115-Vac I/O Monitoring Blocks #1 and #2

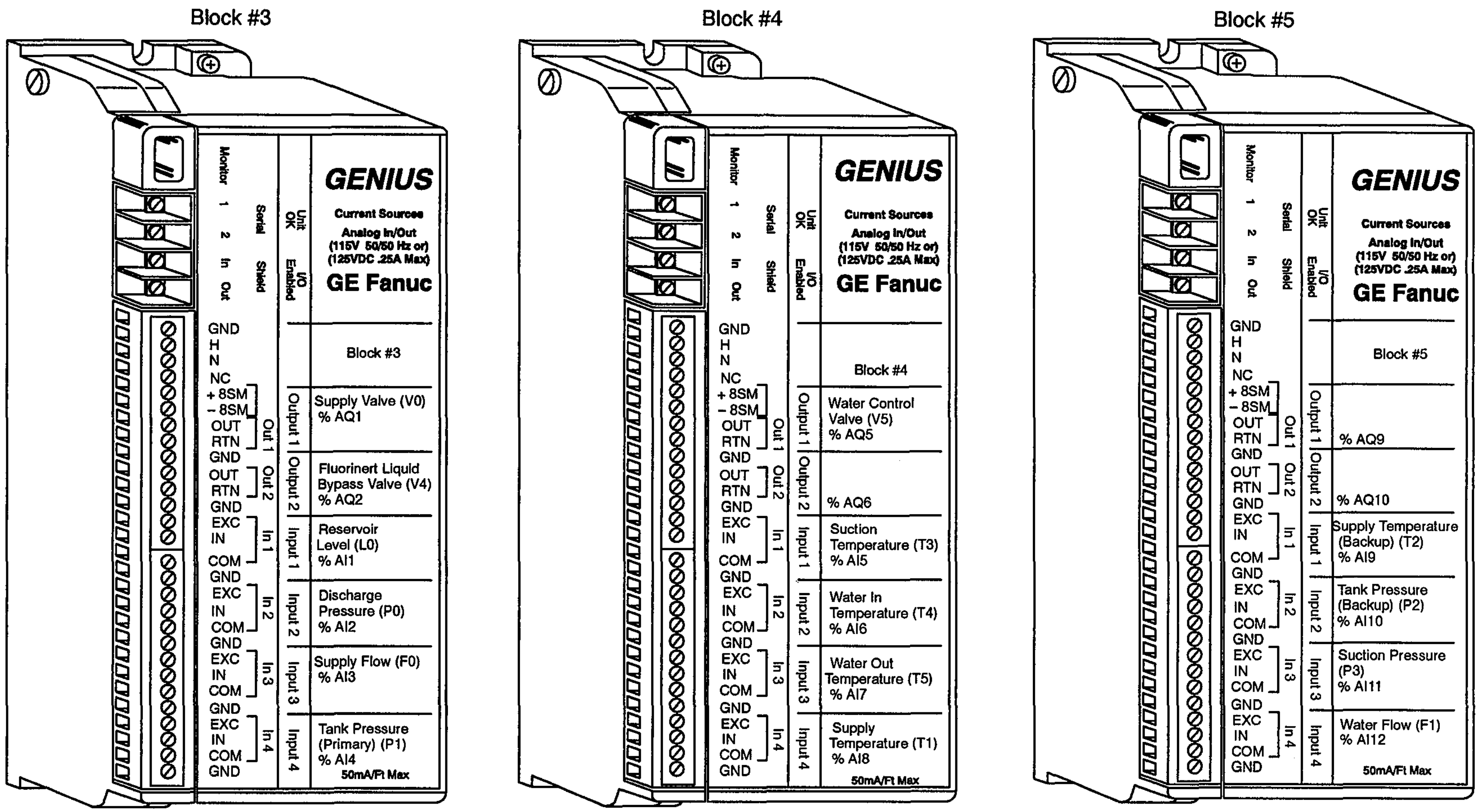


Figure 19. Analog I/O Monitoring Blocks #3, #4, and #5

Monitored Conditions and Limits

Sensors within the HEU-T90 monitor the water and dielectric coolant for certain conditions and ranges. Table 4 provides the sensor type, function, and limits for each monitored condition.

Table 4. Monitored Conditions and Limits

Monitored Condition	Label	Sensor Type	Function	Limits	
				High	Low
Discharge pressure	P0	Pressure transducer	Monitors the discharge pressure of dielectric coolant from the pump		
Suction pressure	P3	Pressure transducer	Monitors the suction pressure of dielectric coolant before the pump		
Tank pressure †	P1 and P2	Pressure transducer	Monitors the pressure of dielectric coolant going through the supply line to the mainframe tank		
Suction temperature	T3	Temperature transducer	Monitors the temperature of the dielectric coolant before the pump		
Water-in temperature	T4	Temperature transducer	Monitors the temperature of water going into the heat exchanger		
Water-out temperature	T5	Temperature transducer	Monitors the temperature of water coming out of the heat exchanger		
Supply temperature †	T1 and T2	Temperature transducer	Monitors the temperature of dielectric coolant leaving the heat exchanger		
Supply flow	F0	Flow meter	Monitors the flow of dielectric coolant leaving the pump		
Water flow	F1	Flow meter	Monitors the flow of water leaving the heat exchanger		
Reservoir level	L0	Level sensor	Monitors the level of dielectric coolant in the reservoir		
Pump temperature	T0	Temperature transducer	Monitors for pump overtemperature condition		

† Primary and backup sensors are used for this monitored condition.

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Table 4. Monitored Conditions and Limits

Monitored Condition	Label	Sensor Type	Function	Limits	
				High	Low
Discharge pressure	P0	Pressure transducer	Monitors the discharge pressure of dielectric coolant from the pump	N/A	N/A
Suction pressure	P3	Pressure transducer	Monitors the suction pressure of dielectric coolant before the pump	N/A	N/A
Tank pressure †	P1 and P2	Pressure transducer	Monitors the pressure of dielectric coolant going through the supply line to the mainframe tank	35 PSI	19 PSI
Suction temperature	T3	Temperature transducer	Monitors the temperature of the dielectric coolant before the pump	N/A	N/A
Water-in temperature	T4	Temperature transducer	Monitors the temperature of water going into the heat exchanger	N/A	N/A
Water-out temperature	T5	Temperature transducer	Monitors the temperature of water coming out of the heat exchanger	N/A	N/A
Supply temperature †	T1 and T2	Temperature transducer	Monitors the temperature of dielectric coolant leaving the heat exchanger	22 C 71 F	15 C 59 F
Supply flow	F0	Flow meter	Monitors the flow of dielectric coolant leaving the pump	+6 gpm Above normal ††	–5 gpm Below Normal ††
Water flow	F1	Flow meter	Monitors the flow of water leaving the heat exchanger	N/A	N/A
Reservoir level	L0	Level sensor	Monitors the level of dielectric coolant in the reservoir	N/A	Warning at 5% (but no shutdo.)
Pump temperature	T0	Temperature transducer	Monitors for pump overtemperature condition	N/A	N/A

† Primary and backup sensors are used for this monitored condition.

†† Dependent on the IOS/SSD type

Self-monitoring Features

The control system uses returned values to control the actuated valves in the HEU-T90. Two PID (proportional plus integral plus derivative) systems control and monitor the following conditions:

- Temperature of the dielectric coolant leaving the heat exchanger
- Flow rate of the dielectric coolant entering the mainframe

Two temperature transducers (primary and backup) monitor the temperature of the dielectric coolant leaving the heat exchanger. If the temperature is warmer or colder than the desired temperature (+1 to –3 °C), signals are sent to the bypass valve (V4) or the water control valve (V5) to adjust the amount of warm dielectric coolant bypassing the heat exchanger or the amount of water going through the exchanger.

The flow rate of the dielectric coolant leaving the pump is also monitored. If the flow rate is too low or too high, the control system sends a signal to the actuated supply valve that controls the rate of flow going to the mainframe. The control system adjusts the supply valve to regulate the amount of dielectric coolant flowing to the module cabinet.

Troubleshooting

To be provided.

Reader Comment Form

Title: **Heat Exchanger Unit (HEU-T90)**
Power, Cooling, and Control System
Preliminary Information

Number: **HTM-xxx-x**
September 1994

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